Memorandum

MIAMI-DADE COUNTY

Date: December 15, 2005

RTC
AGENDA ITEM NO. 7(I)

To: Honorable Chairman Joe A. Martinez
and Members, Board of County Commissioners

From: George M. Burgess
County Manager

Subject: Installing Cameras at Certain Dangerous Intersections

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On August 23, 2005, the Board of County Commissioners (BCC) approved Resolution No. R-937-05 directing me to explore the feasibility, cost, and benefit of installing cameras at certain dangerous signalized intersections to reduce red-light running infractions. I was further instructed to report my findings within 90 days, including recommendations on how to develop such a program and the feasibility of implementing a pilot project. As such, I am providing the following information.

The Public Works Department (PWD) issued a work order to Kimley-Horn and Associates, Inc. (KHA), the consultant currently engaged in developing the Advanced Traffic Management System (ATMS). KHA conducted a study to evaluate potential red-light running detection and enforcement systems for use in Miami-Dade County. Attached, please find a copy of the final draft report, which includes a one (1) page Executive Summary.

Notwithstanding, below please find a summary of the report's findings:

Red Light Running Enforcement (RLRE) systems are installed in at least 100 jurisdictions throughout the United States (US). However, Red Light Running Detection (RLRD) systems, which are identical to RLRE systems, with the exception that warning letters are issued instead of citations, are not currently installed. RLRE systems are not considered legal by the State of Florida, or in approximately a dozen other states. RLRD systems are legal, but are rarely installed for two (2) major reasons explained below:

1. RLRE and RLRD systems achieve the greatest improvement in driver behavior when their implementation is accompanied by a major public information campaign. In fact, the public information campaign appears to provide the wanted benefit, while the RLRE system just gives it the "teeth". RLRD systems provide some degree of "teeth" early on, but their inability to issue tickets eventually leads to their not being successful in the long run. This is one of the major reasons that RLRD systems are not popular.

2. RLRE and RLRD systems cost approximately $60,000 per approach. In RLRE systems, that investment is usually recouped in a few months by issuing tickets. In RLRD systems, that investment is never recouped. Therefore, RLRD systems must be funded from general revenue sources. This is the other major reason that RLRD systems are not popular.

To successfully curtail red light running in a jurisdiction the size and population of Miami-Dade County, a large number of signalized approaches would have to be implemented. A pilot project of 20 approaches could be undertaken which would enable us to evaluate the effectiveness of such a program. The installation cost would be approximately $2 Million, including a major public information campaign.

Despite the costs, several small cities in the State are considering installing RLRD systems on a small scale. Also, the next legislative session is expected to consider a bill proposed to make RLRE systems legal in Florida in the future. I have requested the Office of Intergovernmental Affairs to monitor this item during the next session.

Based on the disadvantages of RLRD systems as described above, the consultant recommends against pursuing this program until such time as the Florida Legislature legalizes RLRE systems. If the Commission decides to proceed with a pilot project, I will direct the Public Works and Procurement Departments to prepare a Request for Proposal for issuance to the half-dozen known firms that install such systems throughout the country.

Assistant County Manager

10/5/05
Date

Final Draft Report
Red Light Camera (RLC) System Study

Advanced Traffic Management System (ATMS)
Work Order No. 11

Prepared for:

Miami-Dade County
Public Works Department

Prepared by:

Kimley-Horn and Associates, Inc.
Fort Lauderdale, Florida

November 2005
191141003

November 30, 2005

EXECUTIVE SUMMARY

On August 23, 2005, the Miami-Dade Board of County Commissioners (MDBCC) directed the Miami-Dade County Manager to explore the feasibility, cost, and potential benefits of installing cameras at the most dangerous intersections in Miami-Dade County to curb red-light running and issue warning letters to the owners of vehicles that run red lights (See Appendix A). The MDBCC also directed the Miami-Dade County Manager to recommend whether and how to implement such a program, and the feasibility of a pilot project. Accordingly, Miami-Dade County's Public Works Department issued a work authorization to Kimley-Horn and Associates, Inc., to conduct a study to evaluate potential red light running detection and enforcement systems for use in Miami-Dade County (See Appendix B).

This study includes a literature review of previous relevant studies, a list of major vendors/integrators in the United States, an evaluation of benefits, challenges, and issues associated with red light running camera systems, a review of FDOT's 2003 High-Crash Intersection List for Miami-Dade County, and the identification of potential funding sources.

The overall feasibility of implementing a Red Light Running Detection (RLRD) system was based on the research performed and inquiries made of Red Light Camera (RLC) vendors/integrators, RLC end-users, and transportation/traffic professionals. In this assessment it was evident that RLC systems, in conjunction with additional engineering improvements/countermeasures, are indeed an effective tool in improving traffic safety. However the two types of RLC systems, RLRD and Red Light Running Enforcement (RLRE), have significant differences.

RLRE systems allow law enforcement officials to issue citations that assess fees to red light running, RLRD systems only allow the issuance of warnings. This difference is significant for two reasons. First, although safety improvements are realized when RLRD systems are first deployed, these improvements are transient in nature. Once motorists realize that there is no true penalty associated with the warnings received after committing an RLR violation, they will begin to revert back to their previous driving behaviors, resulting in the reduction of the safety benefits initially produced by the RLRD system. Secondly, no revenues are generated through the issuance of warnings as there are in the issuance of traffic citations. Therefore the cost of the system must be entirely financed through other means. There are two options for procuring an RLC system: direct purchase or leasing of the RLC system when solely used for the detection/monitoring of RLR violators. Procuring an RLRD system through direct purchase would cost approximately $60,000 per approach while leasing the system for approximately $4,000 per

approach per month could result in an investment in excess of $200,000 for the duration of the lease term, typically three or five years.

Although RLRD systems may provide some degree of improvement to traffic safety through the reduction of RLR occurrences, these may not be sustained improvements. As such, the RLRD system would not be considered a viable long-term engineering countermeasure/improvement to curb RLR in Miami-Dade County. In addition, the magnitude of the investment costs necessary for a RLRD system makes it difficult to justify choosing to implement this tool for what may appear to be unsubstantial or transient improvements. Utilizing the alternative procurement method of leasing the system still requires a large time commitment of at least three to five years. Opinions on the best methods and approaches to curb RLR may change drastically among officials and/or traffic operations and safety professionals in Miami-Dade County, leaving the County with the financial burden of a tool that may become unwanted or perceived as inadequate over time. For these reasons, it is our professional opinion that more cost-effective improvements/countermeasures should be explored to curb RLR in Miami-Dade County, such as those mentioned earlier in this report.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AASHTO – American Association of State Highway and Transportation Officials

ACR – Annual Crash Rate

AADT – Annual Average Daily Traffic

ATMS – Advanced Traffic Management System

AVG – Average

DMV – Department of Motor Vehicles

FDOT – Florida Department of Transportation

FHWA – Federal Highway Administration

ITE – Institute of Transportation Engineers

LED – Light Emitting Diodes

MDBCC – Miami-Dade Board of County Commissioners

MDX – Miami Dade Expressway Authority

NHTSA – National Highway Traffic Safety Administration

NTSB – National Transportation Safety Board

PAC – Public Awareness Campaign

PCCTST – Polk County Community Traffic Safety Team

PSA – Public Service Announcement

RS – Ranking Score

RFP – Request for Proposal

RLC – Red Light Camera

RLR – Red Light Running

RLRD – Red Light Running Detection

RLRE – Red Light Running Enforcement

SHSP – Strategic Highway Safety Plan

INTRODUCTION

Red Light Running (RLR) is defined as a violation that occurs when a motorist enters an intersection while the traffic signal controlling the approach displays red. Due to the direction of travel of the participants involved in most RLR crashes, they are usually characterized as right-angle crashes in accident statistic tables. Nationwide, in 2003 more than 900 people were killed and an estimated 176,000 were injured in crashes that involved red light running. A nationwide study of fatal crashes at traffic signals in 1999 and 2000 found that approximately 20 percent of motorists involved failed to obey the traffic signal indications.

In an effort to reduce the occurrences of RLR at signalized intersections, cities and/or counties in several states have begun utilizing Red Light Camera (RLC) systems. An RLC system uses a camera, video, or series of cameras and/or videos to record when a motorist commits an RLR violation. When a violation occurs, the recording device (camera and/or video camera) captures the image of the vehicle's license plate and records the date, time, and time duration into the red phase, as well as the location of the violation. If a warning or no action is taken other than to monitor and record the violation, this RLC system is referred to as a Red Light Running Detection (RLRD) system. If a citation is issued and mailed to the owner of the vehicle, this system is referred to as a Red Light Running Enforcement (RLRE) system. [1]

In the case of a RLRE system, there are two types of violations that can be assessed to the RLR violator depending on the type of RLC system:

- Non-moving Violation
- Moving Violation.

In the case of a non-moving violation, the citation that is issued to the violator is considered to be similar to that of a parking ticket. There are no points assessed to the driving record of the vehicle owner and no need to confirm the identity of the driver that committed the RLR violation. In the case of the moving violation, an additional photo of the individual driving the vehicle must accompany the photo of the vehicle's license plate in order to properly identify the driver of the vehicle at the time of the violation.

The driving record of the actual driver of the vehicle is negatively affected rather than the owner of the car. Additional equipment is required to obtain a frontal picture for driver identification.

Currently, RLC systems can be found in more than 100 communities across the United States. Due to the legislation governing the implementation of these RLC systems in their various locations, they all start off as RLRD systems. During this "burn-in" period, which can last anywhere from 30 to 180 days, motorists are made aware of the system's presence and educated as to its purpose. In some RLC systems, when a motorist commits an RLR violation during the burn-in period, a warning citation is mailed to the motorist. At the end of the burn-in period, the system progresses to an RLRE system when full-fledge enforcement begins.

According to the Insurance Institute for Highway Safety, Highway Loss Data Institute, as of November 2005, RLC systems are implemented in 20 states and the District of Columbia (See Appendix C). RLC systems are prohibited as a tool for enforcement in 11 states:

- Alabama
- **Florida**
- Kentucky
- Nebraska
- Nevada
- New Mexico
- North Dakota
- Ohio
- Tennessee
- Utah
- Wisconsin

Automated Enforcement of Traffic Signals: A Literature Review reported nationwide violation reductions ranging from 20 percent to 87 percent, with half of the jurisdictions reporting between 40 percent and 62 percent reductions in red light violations [(2)] at intersections where RLRE systems were implemented.

RLRD systems are virtually identical to RLRE systems with the exception that RLRD systems do not provide for the generation and mailing out of citations that assess fines to motorists who commit an RLR violation. In some cases RLRD systems can be used to mail warnings to RLR violators, as was found in the 1994 Federal Highway Administration (FHWA) RLRD system study conducted in Polk County, Florida.

In 1994 the FHWA funded a study proposed by the Polk County Community Traffic Safety Team (PCCTST) conducted in four Florida cities (Bartow, Fort Meade, Haines City, and Lakeland) to test and evaluate automated photo traffic enforcement technologies used to deter traffic violations (RLRE systems). The study utilized RLRD systems to issue warning letters to RLR violators along with informational material to educate violators of the problems and dangers associated with red light running. The cameras used in the system were leased from the vendor for the 6-month duration of the study. Overall, the study showed that the RLC systems were an accurate, safe and cost effective means [3] to curb RLR. For the one year pre and post Polk County RLR campaign, there was 7.3 percent reduction in crashes in Polk County, while there was a 5 percent increase in crashes statewide during this period. [4] The researchers of the study believe that these improvements may be attributed to the RLR public awareness campaign, but concede that additional data would be needed to validate the findings. It should also be noted that the RLRD systems were solely used as evaluation tools to determine the effectiveness of RLRE systems and were not intended to be used as the actual tool to curb RLR.

Presently in the State of Florida, State Statues prevent law enforcement agencies from using photo enforcement to cite motorists who commit RLR violations. According to Florida Attorney General, Charlie Crist, it is unlawful to issue red light camera citations without the sanction of the state legislature, which they presently do not have. However, in written opinions by Mr. Crist, Florida counties/cities are allowed to deploy and utilize RLRD systems (See Appendix D).

FHWA RLR SYSTEM IMPLEMENTATION GUIDELINES

Based on the FHWA National Highway Traffic Safety Administration's January 2005 publication, *Red Light Camera Systems Operational Guidelines* (See Appendix I), there are recommended guidelines for properly implementing an RLC system. These steps have been outlined in the following paragraphs of this section.

RLR High Risk Intersection Identification

One of the initial steps to implementing an RLC system or any other RLR countermeasure is to first identify the intersection as being a significant RLR risk location. This can be determined by reviewing the intersection's crash history, identification by law enforcement agents as having significant red light running violations, and/or through public complaints. [5] In the case of implementing an RLC system, identifying an intersection as a location of significant RLR risk is necessary because of the high investment cost. This RLR risk designation is determined not only by investigating the crash rates, but the types of crashes at the intersection as well. Identifying the crash types helps to distinguish the intersection as being a high RLR risk intersection rather than just a high-crash intersection.

Engineering Improvements/Countermeasures

Once the intersection has been identified as a high RLR risk, engineering improvements/countermeasures should be explored to reduce the incidences of RLR:

- Lengthen Yellow Interval - One of the most widely implemented engineering countermeasures is to ensure that proper length yellow intervals exist for all phases of the intersection's timing plan. In a study performed by the Texas Transportation Institute, lengthening the yellow interval by one second more than the recommended ITE value reduces crashes by 40 percent and violations by 53 percent. [2] It must be noted that although lengthening the yellow interval may reduce signal violations, an interval that is too long could decrease the capacity of the intersection and increase the delay to motorists. Present thought is that longer intervals will breed disrespect for the traffic signal.[12]
- Use of the All-Red Interval – Incorporating an additional period of time, typically 1 – 3 seconds in length, where all approaches have the red phase interval. This period of time allows motorists already in the intersection to proceed through without threat of oncoming cross traffic.

- Improving Signal Head Visibility – Increasing the size of the traffic signal lamps from 8 inches to 12 inches or the implementation of high visibility displays such as Light Emitting Diodes (LED) signal heads. This is especially beneficial on streets that run east-to-west direction where the sun can obscure the visibility of the signal lamps. The use of a back plate on the signal head also helps to improve its visibility.
- Additional Signal Heads – Adding additional signal heads to multi-lane approaches can help to prevent the uncertainty of the current phase in the case that one signal head has a burn-out or becomes blocked from the motorist's view. In addition, near side signal head may also be used to supplement far side displays.
- Signalized Intersection Warning Signs – Signs posted upstream of the intersection to alert motorists of the upcoming signalized intersection. This is particularly useful for roadways that have intersection visibility problems based on dramatic curvature or steep grade issues.
- Advanced Yellow Flashing Lights – Posted on advance Signal Ahead Signs to indicate to the motorist that they are approaching a signalized intersection. This is particularly useful for approaches with high speeds coming into the intersection and/or steep grade approaches.
- Adjusting the Approach Speed – Coordinating the approach speed with the timing plan for each phase to ensure proper/sufficient yellow and all-red phase intervals.
- Traffic Signal Coordination – Coordinated signals to ensure motorist move smoothly in a platoons from intersection to intersection.
- Advance Vehicle Detection – Allows for the maximum extension of the green phase interval to ensure motorist progress smoothly in a coordinated manner.
- Removal of Unwarranted Traffic Signals – Replacing unnecessary traffic signals with 2-way, all-way stop signs, yield signs, roundabouts, etc.
- Removal of On-Street Parking – Restricting on-street parking for a distance of 200 feet from the intersection to increase signage, pedestrian, and cross-traffic visibility.

Public Awareness Campaign

The next step, which should occur concurrently with engineering countermeasures, is to organize a public awareness campaign. The purpose of this campaign is to educate the public, motorists especially, on RLR, the safety issues associated with RLR and dangers of RLR. In addition, the campaign should discuss the engineering countermeasures and other efforts that are in place to help mitigate the current RLR situation. The campaign should stress pertinent statistics such as the number of fatalities and injuries per year that are attributed to RLR. The emotional and economical loss to the families of RLR victims should be a key point in the campaign. In addition, the indirect costs generated as a result of RLR should be stressed as well. Information on how RLR crashes affect not only those directly involved but the public as a whole through higher insurance premiums, loss of productivity, and medical costs [5] should be provided. An emphasis should be placed on how motorists can help reduce RLR by taking preventative measures such as obeying traffic laws, driving within the posted speed limits, and being aware of their surroundings as they approach and enter the intersection.

RLC System Implementation

If the above countermeasures alone are not sufficient to adequately reduce the number of RLR incidences then the implementation of an RLC system in conjunction with these countermeasures may be warranted. In the initial phases of implementation, there are a few key tasks that need to be performed.

First a steering committee should be established that incorporates the participants from all the various organizations involved. This may include, but is not limited to, organizations such as:

- State Department of Motor Vehicles
- State and Local Police and Sheriff's Department
- Traffic Engineering Department
- Public Works Department
- City, County, or State Attorney's Office
- City, County, or State Public Information Office or Community Affairs Judiciary
- Photo Detection Service Contractor
- Selected Community Representatives

This committee is responsible for overseeing the RLC system from its inception and monitors the progress and results to ensure the system is operating effectively.

Once the steering committee has been formed, the next focus is to identify the necessary legal requirements. Currently in the State of Florida, law enforcement agencies are not authorized to utilize RLR photo enforcement to automatically assess fines and mail tickets to RLR violators, therefore a true RLRE system can not be deployed. However, law enforcement agencies are authorized to use the same camera system to monitor intersections and in some cases send out warnings to RLR violators. This stipulates the use of an RLRD system since it only detects RLR violators and provides no real means of enforcement through fines and/or penalties.

Once the RLC system has been installed, there is typically a 30 - 180 day burn-in period to ensure that the system is functioning correctly. During this period of time, public announcements should be made to inform motorists of the presence of the RLRD system at the specified intersection(s). The necessity and importance of having the system in place should also be reinforced. Within this burn-in period, the accuracy and reliability of the system should be verified. At the end of the 30-day period, if the system is functioning properly, then the issuance of warnings would commence.

LEGISLATIVE ISSUES IN FLORIDA

Presently in the State of Florida, law enforcement agencies are not authorized to use photo enforcement to cite motorists who commit RLR violations. According to Mr. Crist, it is unlawful to issue red light camera tickets without the sanction of the state legislature which they presently do not have. However in Mr. Crist's letter to the City of Pembroke Pines Attorney, Samuel S. Goren (See Appendix D), he stated that an ordinance could be enacted authorizing the City to monitor violations of traffic signals within the City and to use unmanned cameras to monitor intersections and record traffic violations. In essence, this enables Florida counties/cities to deploy and utilize RLRD systems.

However there is currently a bill being proposed by Representative Ron Reagan before the Florida House of Representatives HB 259 – Red Light Violations (See Appendix E) that would provide a county or municipality the ability to enforce red light running on local roads using RLC systems. If passed, the

county or municipality would then be authorized to provide citations to the owner of the motor vehicle identified as running the red light that would assess a civil fee for the offense.

In addition, there does appear to be increasing support at a local agency level for RLRE. A consortium of RLRE advocates has been formed in Sarasota County by Bonita Springs City Council to present their RLRE initiatives before the General Assembly.

A timeline of the RLC system bills that have been filed with Florida House of Representatives and Florida Senate have been summarized in table provided below:

Timeline of RLC System Legislation in Florida			
Session Year	Bill Number	Bill Name	Bill Action
2006	HB 259	Red Light Violations	Filed
2005	HB 1439	Red Light Violations	Died in Transportation Committee
2004	No History of Any Bill Being Filed in House or Senate		
2003	HB 337	Uniform Traffic Citations	Bill Withdrawn
2002	HB 21	Red Light Safety Act of 2002	No History On Record
2001	HB71 HB 1033 SB 1830	Red Light Safety Act of 2001	No History On Record
2000	HB 1159 SB 1436	Red Light Safety Act of 2000	No History On Record
1999	SB 266	Traffic-infraction Detectors	No History On Record
1998	SB 2046 HB 133	Traffic Control/Automated Monitor Traffic Control/Red Light	No History On Record

Table 1. Timeline of RLC System Legislation in Florida

RED LIGHT CAMERA PROGRAMS

Based on the information gathered from the vendors/integrators in this report, there currently are no ongoing implementations of RLC systems for the sole purpose of monitoring/detecting RLR violators (RLRD systems) in the nation. Although in the initial stages of deployment the RLC system are installed as RLRD systems, these systems are primarily used for a 30 to 180 day period to either justify

implementing an RLRE system at the intersection or verify that a system is functioning properly (testing accuracy and reliability) before it "goes live" with enforcement.

In State RLC Programs

The last true implementation of an RLRD system in Florida was in 1994. This was a study funded by the Federal Highway Administration (FHWA), conducted in Polk County (Bartow, Fort Meade, Haines City, and Lakeland), to determine the effectiveness of RLC systems as a tool to curb RLR. In the study, researchers experienced some difficulty attempting to identify RLR violators from different states, a significant problem due to Florida's large tourist population. It was also observed that large trucks blocked the camera's ability to capture RLR's in adjacent lanes. However, overall the study was able to confirm that RLRE systems were indeed an effective tool to be used in conjunction with other engineering countermeasures/improvements to lower RLR violations through the information obtained from the RLRD systems in place during the study.

The study, which was conducted over a six-month period, showed a substantial reduction in the number of RLRs. This is attributed to the heavy press coverage (newspaper, radio, etc.) and "warnings" that were distributed to RLR violators. Press releases listing the location of the RLRD systems and the RLR statistics for each of those intersections were issued at least once a week. Public Service Announcements (PSAs) were frequently broadcasted on the radio. In addition, each RLR violator was mailed a "warning" indicating that they were observed running the red light and received pertinent RLR statistics (number of crashes, severity of crashes, cost, etc.) to better inform them of the dangers associated with running red lights. At the end of the six-month evaluation study the cameras were removed. Approximately three months after the cameras were removed and the press releases and PSAs were discontinued, the RLR improvements started to regress. By the sixth month, RLR conditions had returned to as they were before the start of the study.

In discussions with Patrick Brady, Transportation Safety Engineer in the FDOT Central Office, the success of the RLRD program was heavily weighted on the "newness" of the program, in that motorists were not aware of the ramifications of the warnings being issued. [15] Another heavily weighted factor was the tremendous sustained press effort that accompanied the study, in which the public was provided up-to-date relevant information and statistics about RLR on a continuous basis. It is this total concerted organized effort, in Mr. Brady's opinion, that led to the overall success of the program.

There are several cities and counties in the State of Florida that are currently planning on implementing RLRD systems. All of theses cities and counties will initially be implementing these systems as pilot programs, incurring no upfront cost. Vendors have demonstrated their willingness to partner with these cities and counties in hopes that legislation in Florida governing RLRE will change.

In regards to issuing warning letters, the cities and counties implementing these RLRD systems fall into one of three categories (1) Will issue warnings, (2) Will not issue warnings (information gathering), (3) Undecided. The cities are listed below in their respective category.

Will Issue Warnings

- City of Gulf Breeze
- City of Pembroke Pines [(a)]
- City of Orlando
- Sarasota County

Will Not Issue Warnings

- Manatee County

Undecided

- City of Melbourne
- City of Pensacola

[(a)] The City of Pembroke Pines will be only issue warnings for a 6-month period and then will proceed to "go live" with enforcement, potentially a violation of State statutes.

At the City of Pembroke Pines Commission meeting on Wednesday, October 19, 2005, Ordinance 2005-22: Pembroke Pines Dangerous Intersection Act, was approved which allows for the set up of red light enforcement (See Appendix F). Currently, the City of Pembroke Pines is working on revising the language of this ordinance and has not yet decided when they will proceed with their RLC system.

The City of Gulf Breeze adopted a similar resolution on August 15, 2005. This is despite an explicit warning from the State's Attorney General that such ordinances could not be passed without new legislative authority. Gulf Breeze intends to install one RLC system on property owned by the Santa

Rosa County School Board at the intersection of US 98 (FDOT facility SR 30) and Daniel Drive without encroaching on FDOT property. [14] The City attempted to coordinate this project with FDOT, but FDOT was not willing to allow cameras or any other equipment on FDOT facilities. The Santa Rosa County School Board however is in full cooperation of the City's RLC system efforts, and as such made their property available to the extent necessary.

The system the City plans to implement will not require them to obtain any access to the traffic signal controller cabinet. This is of importance since as of October 5, 2005, in accordance with FDOT's position on red light running cameras, it is not permissible to install RLC systems within the FDOT right-of-way to monitor any State Highway system. [15] Therefore, with the intended design of the RLC system that the City of Gulf Breeze plans to implement, they seem to be in accordance with FDOT's current position. The City of Gulf Breeze plans to issue non-moving violations with a fee in the amount of $100 that will be a civil infraction notice. This civil infraction will not be a Uniform Traffic Citation (UTC), but instead similar to a code violation, such as a noise ordinance. If it is determined that a motorist has ran a red light, they will be assessed a fine for the violation of a "code" not a traffic law.

Sarasota County is also planning on implementing RLC systems at two intersections in the County. They are currently in the process of advertising a Request for Proposal (RFP) to RLC vendors/integrators willing to install their systems at no cost or under a lease option. The County initially intends to use the RLC systems to issue warning letters to RLR violators and collect data for RLR statistics to present to the County Commission. The County's RLRD system program will run for approximately 3 months while they wait to see if any significant changes are made to the current legislation governing the use of unmanned cameras for enforcement. If no changes are made to the current legislation, the County will then re-assess if they want to continue their pilot program.

A questionnaire was distributed to the Chief of Police in various cities within Miami-Dade County to obtain their opinion on implementing RLC systems to automate the enforcement of red light running in Miami-Dade County. This was done in an effort to assess the involvement, support, and commitment of the local police departments to such a program in the event that RLC systems were to be implemented in their district. Whether an RLC system is being used for enforcement to issue citations or for detection purposes where warnings may be issued, both still require an officer to review the evidence to determine if a violation was indeed committed. This requirement is an established protocol of most RLC

vendors/integrators to reduce the number of questionable infractions that may have resulted had not a trained law enforcement agent reviewed the potential violation. Out of the 19 questionnaires that were sent out, only two of the Chiefs of Police that were contacted replied, Miami-Dade and City of Homestead. Their responses illustrate that they support the use of RLC systems in Miami-Dade County, but only the Miami-Dade Chief of Police was willing to devote the manpower needed to make the systems effective. Their responses can be found in Appendix G.

Out of State RLC Programs

In 2002, a pilot RLRE program was conducted in the City of Dubuque, Iowa. The NHTSA provided the State of Iowa with funding to set-up an RLC system at one of the State's busiest intersections for a trial period of six months. During the trial period, no citations or warnings were sent out to motorists that committed RLR violations. Instead, the data was recorded and tracked to formulate RLR statistics to support the potential ordinance that would be needed to allow automated RLRE. There were no records regarding RLRE in the City of Dubuque before the six month study began, therefore the effectiveness of the RLRE program could not be substantiated with a before-and-after study. At the end of the trial period it was realized that the number of citations the City was assessing per day would not be enough to finance the RLRE system, and so efforts to continue the program ceased

In 2003, another pilot RLRE program was conducted in the cities of Overland Park and Olathe, Kansas. Three intersections were studied as a part of the pilot program: two of the intersections were in Overland Park (Hawthorne/119th and Quivira/95th) and the remaining intersection was in Olathe(Santa Fe/Mur-Len). The pilot program monitored one approach at each of the three intersections. Each of the intersections utilized a different type of RLC technology to monitor the intersection. At the intersection of Hawthorne/119th a wet film camera was used. At the intersection of Quivira/95th a digital video camera was used. At the intersection of Santa Fe/Mur-Len a digital camera was used. The cameras at each intersection were installed for monitoring purposes only and no citations or warning were issued for red light violations observed by the camera system. [9] The start-up costs for the systems ranged between $98,000 and $130,000 depending on the camera system. This cost included the cameras, installation, management of images, and basic computer hardware and application software. The respective cost at each of the intersections is as followed:

- Hawthorne/119th (wet film camera) ..... $120,000[b]
- Quivira/95th (digital video camera) ..... $98,000[b]
- Santa Fe/Mur-Len (digital camera) ..... $130,000[b]

(b) Cost do not include local (city) personnel time and expenses to manage the projects, perform inspections, and data collection efforts.

In the early stages of the study, data from the Santa Fe/ Mur-Len study site in Olathe indicated that the mere presence of a RLR monitoring camera could reduce violations by roughly 25 percent; however, it was not documented how long this reduction could be maintained without any form of enforcement. The study showed that if the RLRE system were to be implemented at the three intersections, there were no indications that the same success in RLR reduction (40 to 60 percent) as found with other RLRE programs would not be attained.

POTENTIAL FUNDING SOURCES

Currently there are no federal funding sources allocated for RLC systems in the State of Florida. This is primarily due to the current State Legislation, Section 316.640, Florida Statutes, which does not allow for the enforcement (issuance of citations) of RLR using unmanned camera (electronic traffic infraction detector) systems. [18] The controversy surrounding what constitutes a violation of current Florida Statutes in regards to RLC systems, whether they are RLRE or RLRD systems, has prompted federal agencies to take their current position of not providing funding.

Instead, funding to curb RLR occurrences from the State's Strategic Highway Safety Plan (SHSP) is being dedicated to public awareness campaigns and "enforcement" or "white" lights. "White" lights are lights that are affixed to the traffic signal heads and coordinated with the red phase of the designated approach. The light turns on when the red phase begins for that approach. This then allows the law enforcement agent to be positioned downstream of the signal and still accurately observe when an RLR violation has been committed. In an effort to promote an effective safety measure which is not in violation of Florida Statues, the FDOT is subsidizing the cost of "white" light systems hardware, less the cost of the bulbs. Cities such as Ocala, Tallahassee, Orlando, and others have already taken advantage of the FDOT funded program from their respective FDOT Districts. An initiative in the City of South Miami is currently in place to begin implementing the FDOT's "white" light system. However, due to

present inability of the "white" lights to operate properly with the conflict monitor utilized by Miami-Dade County, the "white" lights have yet to be adopted.

If the current legislation on RLC systems were to change, funding opportunities could be made available through coordination with the FDOT during revision of the State's SHSP. Until that time, local jurisdictions would have to finance the cost of RLC systems with their own funds.

OPINION OF PROBABLE COST

Most vendors/integrators of RLC systems offer the following three procurement options for the purchasing entity to choose from:

- Monthly Lease Fee
- Per Citation Fee
- Direct Purchase

In the first two options, Monthly Lease Fee and Per Citation Fee, there is no upfront cost to the purchasing entity. However, some initial work must be performed by the purchasing entity to ensure that the proposed intersection is indeed a high RLR risk location. Under the Monthly Lease Fee option, once the cameras have been installed there is a monthly fee per camera over a fixed lease term. The revenue generated by the fees collected from citations issued to RLR violators is expected to pay for the monthly cost of the cameras.

In the case of Per Citation Fee, the vendor/contractor of the system is paid a percentage of each citation in order to fund the cost of the system. This option is extremely unfavorable with citizens and has even been outlawed in California.

The last procurement option, Direct Purchase, requires the purchasing entity to buy the system outright. This option is almost never used because of the high cost of the system.

However, in the case of implementing an RLRD system, Direct Purchase is presently the only option since there is no revenue being generated by the warnings being sent to RLR violators. This brings into question the issue of how an RLRD system, which could have a total cost of approximately $60,000 per approach, can be funded by a municipality in the State of Florida. In order to accommodate entities wishing to implement RLRD systems, some vendors offer an option to lease the system over a specified period of time (i.e. 3 or 5 years). A description of the various payment plans offered by RLC vendors/integrators included in this report is listed below:

LaserCraft

LaserCraft's RLC system, Laser RMS, utilizes an above ground laser-sensor technology, Non-Invasive Laser Rangefinder, to offer an alternative to in-ground loops and peizo sensors. Their laser-based speed and positioning measurement technology enables the system to sense impending red light violations. The Laser RMS Camera Assembly captures a minimum of four high resolution digital images of the violating vehicle, including wide angle images of the vehicle at the stop bar and passing through the intersection. In addition to red light running detection, the system can also provide continuous traffic statistics including vehicle count, average speed, etc. The Laser RMS also offers color camera output for live traffic monitoring.

LaserCraft offers a full turn-key system at a cost of approximately $4,000 - $5,000 per month per approach with no installation cost. This system includes:

- Obtain DMV Data
- RLR Violation Detection Statistics Software
- RLR Statistical Reports
- RLR Violation Pre-processing
- RLR Violation Web Video
- Vehicle Owner Identification through DMV records (if permissible)
- All System Maintenance (Cleaning, Repair, Replacement, etc.)

Nestor

Nestor's RLC system, CrossingGuard, combines image processing technology with roadside video cameras to provide an automated detection system. CrossingGuard uses multiple video cameras installed at an intersection to detect and record RLR violations. Once a violation is detected, CrossingGuard video cameras begin recording multiple violation video sequences, showing the violation from different points of view in an effort to capture the full context of the incident. In addition, CrossingGuard incorporates a "Collision Avoidance Safety" feature in which the system uses its video detection capability to predict whether a vehicle will stop in time for the red light. If a violation is predicted, the system will send an emergency request to the traffic controller to briefly extend the red light for cross traffic in an attempt to prevent an intersection collision.

Nestor offers a full turn-key system at a cost of $3,200 per approach per month under a five year agreement. This system includes:

- Roadside Equipment (camera, pole, cabinet communication hook-up, power hook-up, etc.)
- "Back Office" Software (video processing software)
- Maintenance (deployed system, "back office" software, etc.)
- Data Management
- Services (pre-processing video footage, mailing the warnings, etc.)

The services provided by Nestor for this RLRD system do not include the 800 violator support hot line or the internet based violator review option that would be found in their RLRE systems. The purchasing entity would still be responsible for (i) reviewing all violation evidence and approving before a warning was issued, and (ii) obtaining DMV data for identification and mailing purposes. An automated interface to the DMV records for driver identification can be implemented if permissible by FDOT. The purchasing entity could prematurely terminate this agreement at their discretion for a modest fee tied to the unamortized installation costs (not to exceed $75,000 per approach).

Peek Traffic

Peek Traffic's RLC system, SafeStreet, utilizes a non-invasive Doppler tracking radar to triangulate the vehicle's position, speed and direction. The system provides a high resolution (5.4 megapixel) commercial digital camera and one video camera to provide coverage of most intersection approaches.

Toroid signal sensing using small transformers allows the system to know when the signal is illuminated with no hard wired connections to the traffic signal controller. The toroid is a means of interfacing to the signal controller for red light applications using a current transformer to sense the current to the lamps or Light Emitting Diodes (LEDs) in the signal head. Since current will only flow when the red signal light is illuminated, the light will only be recognized by the system as red when it is displayed to the driver of the vehicle as red. Two digital images of the RLR violator are captured by the camera to provide the evidence that a violation has occurred. Video streaming is also provided to help resolve some contested violations but is not used as primary evidence due to its lower resolution in comparison to the digital camera that is used.

Peek Traffic will provide a turnkey red light photo detection for a total monthly fee, per camera system (approach), payable by the County for the proposed turnkey program (includes all construction, installation, hardware, software and operating expenses, including citation warning screening, printing, mailing and management fees). The County will be invoiced monthly. The citations are assessed to the owner of the vehicle so there is no need for driver or front images normally used to identify the actual individual driving the vehicle. With the Peek Traffic system, one approach typically requires only one camera system. Depending on intersection geometry, approaches with more than three or four lanes or dedicated left-turn/right-turn lanes *may* require additional sensors and cameras to be installed; however, the monthly fee will remain the same.

The data below is based on 10 approaches (new camera systems) capturing five violations each per day.

Fixed Fee per red light camera approach (5-frame per second video streaming for secondary evidence)	3 year: $2,400 per approach per month 2 year: $3,100 per approach per month 1 year: $4,200 per approach per month
Fixed Fee per red light camera approach (Full Motion Video for secondary evidence)	$100 additional per approach per month over fees above
Data collection only with pdf files of incidents, no printing or mailing of warnings.	$350 less per approach per month

A typical Bill of Materials for construction per approach is provided below. Quantities may vary depending on actual intersection geometry.

ITEM	Qty	Unit
Camera Pole, galvanized steel, 8.5 ft, w/ Pelco base & anchor bolts	1	each
Flash Pole, aluminum, 13 ft w/ Pelco base & anchor bolts	1	each
Sensor Pole, aluminum, 13 ft w/ Pelco base & anchor bolts	1	each
Flash Housing	1	each
Bracket (Flash)	1	each
Bracket (Sensor)	1	each
Toroid	2	each
Signal Cable	1	Spool
Power Cable	1	Spool
Warning Signs	4	COUNTY
Camera System, RLSS, camera, 2 flash, sensor, enclosure, video	1	each
Firewall @ camera	1	each
DSL Install	1	each
Shipping	1	lot
Installation Technician	40	/hour
Project Manager	40	/hour
Construction subcontractor	1	/site
Installation Technician Travel	1	/week

To purchase the system outright, the cameras would cost approximately $50,000 each. In addition, there is an installation cost of approximately $10,000 per camera. [12]

Redflex

Redflex's RLC system, Redflex Red, utilizes "trigger technology" which includes video, laser, piezo, and in-ground loops depending on what is requested or most compatible with the selected intersection. Redflex Red is a single pole mounted camera system that includes three cameras (up to 12 megapixels) and one video camera. All the cameras are synchronized to a single time source. No roadside cabinet is required since all electronics are contained in the camera housing. The Redflex Red systems has speed sensing and monitoring built-in, in addition to the ability to enable live video streaming. The evidence package consists of (1) a pre-offense high resolution digital image, (2) high resolution license plate image, (3) a post violation high resolution digital image, and (4) a 12-second video showing six seconds prior to infraction and six seconds post infraction.

Redflex offers a full turn-key system at a cost of approximately $3,000 - $3,500 per month per approach with additional installation costs dependent on the type and geometry of the intersection as well as the duration of the program. The system is to be implemented in 6-month increments. At the end of each 6-month period there is the option to extend the lease of the system. The Redflex RLRD system includes:

- RLR Violation Detection Statistics Software
- RLR Violation Pre-processing
- RLR Violation Web Video
- RLR Statistical Reports
- Motorist Speed Data Statistics
- Vehicle Statistics (Type, Quantity, Movement Volumes, etc.)
- Vehicle Owner Identification through DMV records (if permissible)
- All System Maintenance (Cleaning, Repair, Replacement, etc.)

The RLC vendors/integrators listed above provide pre-processing of the RLR violations as part of their turn-key systems. This is done to reduce the number of false-positive RLR violations (i.e. right-turn-on-red when permissible) the system detects before sending the violations to be viewed by the designated law enforcement agent(s) to verify the violation. However, the need for a law enforcement agent to review the footage is optional with an RLRD system and thus at the County's discretion because there is no penalty assessed to the motorist. If the County opted not to have law enforcement agents or any other personnel review the violations that were determined to be valid during pre-processing, then all of those motorists would be sent out warning letters.

Proceeding in this manner would reduce the increased variable cost (i.e. a senior level officer reviewing the video footage would have a higher cost than an entry level officer reviewing the same footage) associated with sending out warning letters to RLR violators. However, there would still be a per letter cost for the mailing and printing of the letters which is approximately $0.55 per letter, based on citations sent out by the Miami-Dade County Clerk's Office, which includes the cost of mailing and printing the citation as well as the cost of the paper. [22] The County could either choose to negotiate this cost into the turn-key system as a lump sum service fee provided by the RLC integrator, as is done by the Miami-Dade Expressway Authority (MDX) with their toll violations, pay a per warning letter processing fee to the RLC integrator, or opt to use their own resources. [23]

Based on recent investigations and inquiries, no RLC system vendor was willing to offer an RLRD system (more than one camera for a duration in excess of six months) at no cost in the State of Florida. However, all the vendors listed in this report have expressed their willingness to provide an RLRD installation for a pilot program in Miami-Dade County at one approach for durations ranging from thirty (30) days to six months.

HIGH-CRASH SIGNALIZED INTERSECTIONS

Intersections where significant red-light running occurs could be determined by obtaining complaints from the general public, local officials and police department, and identifying high-crash locations. The first two methods are valuable but they may be based on public perception rather than factual data. The use of high-crash locations is a starting point for objectively identifying locations where red-light running may be occurring.

Identifying high-crash locations is based on a comparison of crash rates among intersections with similar geometric characteristics. Some of the geometric characteristics include the number of lanes on both the major road and crossing streets, type of median provided on the major roadway, number of legs at the intersection and type of traffic control device used at the intersection.

Comparing intersections solely based on the number of crashes that occurred may mislead results from a crash data analysis. Research has shown that the occurrence of crashes is impacted by the amount of traffic traveling through an intersection. In other words, the more traffic at an intersection, the higher the crash occurrence. Crash rates for intersections are calculated with Equation 1.

$$ACR_{INTERSECTION} = \frac{Number\ of\ Crashes \times 1{,}000{,}000}{AADT \times 365} \qquad \text{Equation 1}$$

where,

$ACR_{INTERSECTION}$ = Actual Crash Rate of Intersection in One Year

AADT = Average Annual Daily Traffic

A statistical analysis is performed to determine if a location is a high-crash intersection a statistical analysis is performed. The statistical analysis compares the actual crash rate against the average crash rate for intersections with similar geometric characteristics. Equation 2 is used to determine the constant *k*, which determines the level of statistical significance of the high-crash location. The statistical significance indicates the probability that a crash rate above the average crash rate is abnormal. The *k* factor is used in the standard normal distribution curve to determine the high-crash confidence level. An intersection with a *k* factor equal to or greater than 3.70 is considered a high-crash location (i.e. high-crash confidence level is at least 99.99).

$$k = \frac{\left(ACR_{INTERSECTION} - AVG + \frac{1{,}000{,}000}{2 \times (365 \times AADT)} \right)}{\sqrt{\frac{AVG \times 1{,}000{,}000}{365 \times AADT}}} \qquad \text{Equation 2}$$

where,

k = Test Factor

$ACR_{INTERSECTION}$ = Actual Crash Rate of Intersection in One Year

AVG = Average Crash Rate of Intersection with Similar Geometry

AADT = Average Annual Daily Traffic

One of the objectives of this study is to determine locations where significant red-light running occurs. An approach to determine potential locations was to use the high-crash list of intersections prepared by the Florida Department of Transportation (FDOT). The major advantages of using FDOT's high-crash intersection list are: (1) the high-crash list is prepared every year, and (2) the high-crash list can be readily obtained. The latter is of special importance since Miami-Dade County does not have an electronic crash database available for reviewing and analyzing. Analyzing crash data for county and municipal roads would require a considerable amount of time obtaining the "hard-copies" of the police crash reports, reading and inputting the information contained in the "hard-copies" in an electronic format, and analyzing the data.

Although FDOT's high-crash list is a good starting point for the analysis, it has some drawbacks: (1) it only includes intersections located along State roadways, (2) it considers all types of crashes that occurred

at the intersections, and (3) it is subject to typical errors observed in crash databases, such as the accuracy of the description and interpretation of police officers and personnel reviewing and inputting the information into a database. Nevertheless, FDOT's high-crash list can provide a quick synopsis of locations that may have safety deficiencies.

This study used FDOT's 2003 high-crash list since it was the latest list available at the time the study began. Appendix H includes the 2003 high-crash signalized intersection list for Miami-Dade County, and Figure 1 depicts the process followed to determine the high-crash list for signalized intersections. The description of the process is as follows:

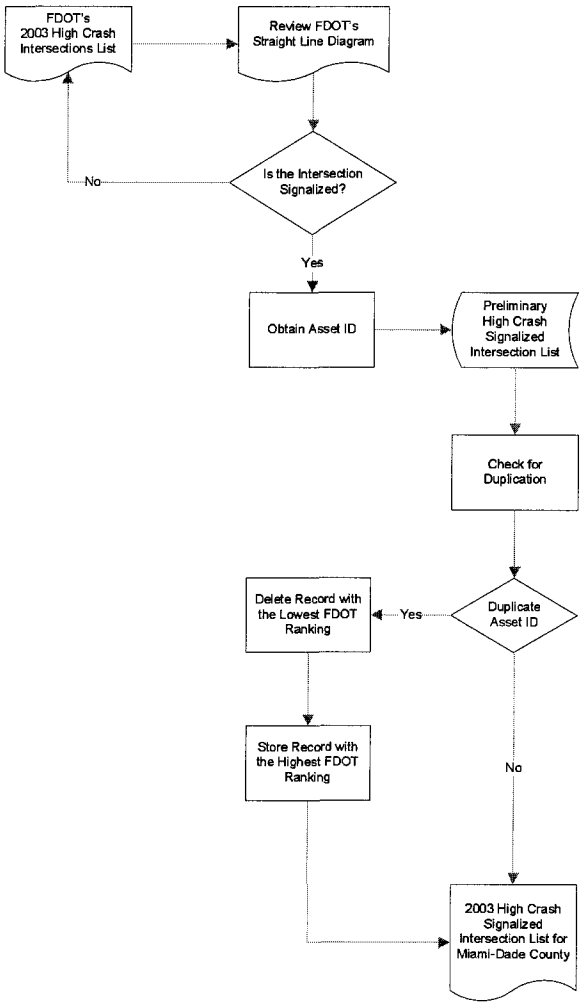

Figure 1. High-Crash Signalized Intersection Identification Process

1) The high-crash list includes both signalized and unsignalized intersections. Thus, FDOT's Straight Line Diagrams were used to determine if the intersections were signalized.
2) Once the signalized intersections were identified it was necessary to obtain their Miami-Dade County identification (i.e., asset ID).
3) Several State Roads in Miami-Dade County are crossed by other State Roads, therefore, the list was reviewed for any duplication. If an intersection was found to be duplicated then it was considered that the record with the lowest FDOT ranking should be deleted.

The intersections included in the high-crash list for signalized intersections were ranked according to a criterion that considered the number of fatalities, number of injuries, number of crashes, and the amount of traffic traveling through the intersection (i.e., traffic exposure). FDOT's ranking was not used because it was solely based on the high-crash confidence level and it could be misleading when selecting the top intersections that may present safety deficiencies. Equation 3 shows how a Ranking Score (RS) was calculated to determine the ranking of the intersections. Table 1 presents a summary of the top 100 signalized intersections, and Figure 2 depicts the high-crash signalized intersections in Miami-Dade County.

$$RS_i = \left(\sum 1.50 \times I + 33.3 \times F + 1.37 \times C\right) \times \frac{M_i}{M_{AVERAGE}} \qquad \text{Equation 3}$$

where,

RS_i	= Ranking Score at Intersection *i*
I	= Number of Injuries; 1.25= 100 points/66 injuries
F	= Number of Fatalities; 33.3= 100 points/3 fatalities
C	= Number of Crashes; 1.37 = 100 points/73 crashes
M_i	= Traffic Exposure at Intersection *i*
M_{AVG}	= Average Traffic Exposure

Although it was previously described, it should be noted that the intersections included in the high-crash list were analyzed by calculating the crash rate with all types of crashes. Therefore, care should be taken in interpreting the intersections presented in the top 100 high-crash signalized intersections list present a red-light running problem.

A next step in the evaluation of intersections where red-light running may be occurring should be obtaining the crash data for the top 100 intersections and analyze the crash data for angle and left-turn crashes to determine if these intersection indeed present a red-light running problem. In addition, a field review should be conducted at those locations where the crash data suggest a red-light running problem to corroborate the information.

Table 2. Top 100 High-Crash Signalized Intersections in Miami-Dade County

KHA's RANK	FDOT'S RANK[1]	MAJOR ROAD	MINOR ROAD	COUNTY ASSETID	RODWAY TYPE	No. OF LEGS	No. OF CRASHES IN 2003	CRASH RATES[2]		NUMBER OF			HIGH CRASH CONFIDENCE LEVEL[4]			
								ACTUAL	AVERAGE	FATALITIES[3]	INJURIES[3]	PROPERTY DAMAGE[3]	2003	2002	2001	2000
1	904	SR 985	SW 8TH ST	3709	U-6DR	4	46	0.969	0.569		43	22	99.99%	95.00%	99.00%	99.95%
2	563	SR 860	SR 7/US 441	2523	U-6DR	4	49	1.272	0.569		40	26	99.99%	99.99%	99.99%	99.99%
3	338	SR 112	SR A1A	2720	U-4DR	4	60	1.231	0.445		12	52	99.99%	99.99%	99.99%	99.99%
4	950	SR 976	SW 87TH AVE	2964	U-6DR	4	40	0.974	0.569		41	20	99.95%	99.99%	99.99%	99.75%
5	987	SR 973	SW 8TH ST	3362	U-6DR	4	38	0.964	0.569		46	18	99.95%	99.95%	99.99%	99.99%
6	343	SR 817	NW 183RD ST	2908	U-6DR	4	50	1.702	0.569		61	20	99.99%	99.99%	99.75%	99.99%
7	972	SR 5	SW 37TH AVE	2186	U-6DR	4	33	1.010	0.569	2	21	20	99.95%	99.99%	99.99%	99.90%
8	290	SR 5	SW 152ND ST	2955	U-6DR	4	51	1.863	0.569	1	44	24	99.99%	99.99%	99.99%	99.99%
9	585	SR 915	NE 167TH ST	2018	U-6DR	4	43	1.302	0.569		47	19	99.99%	99.99%	99.99%	99.99%
10	86	SR 5	N MIAMI BLVD	2537	U-6DR	4	75	2.722	0.569		34	51	99.99%	99.99%	99.99%	99.99%
11	279	SR 90	SW 27TH AVE	2253	U-6DP	4	51	1.851	0.552	1	33	31	99.99%	99.99%	99.99%	99.99%
12	79	SR 976	WB ENT FROM SR 826	3523	U-6DR	3	47	2.259	0.326	2	47	21	99.99%	99.99%	99.99%	99.99%
13	362	SR 968	NW 27TH AVE	2204	U-6DP	4	55	1.507	0.552		26	36	99.99%	99.99%	99.99%	99.99%
14	792	SR 94	SW 107TH AVE	3535	U-6DR	4	40	1.113	0.569		39	15	99.99%	99.75%	99.99%	99.99%
15	452	SR 5	SW 27TH AVE	2182	U-6DR	4	51	1.404	0.569		28	31	99.99%	99.99%	99.99%	99.99%
16	400	SR 5	SW 17TH AVE	2180	U-6DR	4	52	1.492	0.569		29	37	99.99%	99.99%	99.99%	99.99%
17	185	SR 90	WB EXIT TO SR 821	4238	U-6DR	3	40	1.588	0.326		66	13	99.99%	99.99%	99.99%	99.99%
18	541	SR 823	NW 167TH ST	3068	R-OLA	3	47	1.524	0.660		40	27	99.99%	99.99%	99.99%	99.99%
19	271	SR 924	NW 27TH AVE	4619	U-TOL	4	45	1.405	0.387		35	23	99.99%	99.99%	99.99%	99.99%
20	234	SR 5	NE 163RD ST	2010	U-6DR	3	36	1.517	0.326	2	24	15	99.99%	99.99%	99.99%	99.99%
21	502	SR 823	FRONTAGE RD - SR 826	3845	R-OLA	3	45	1.608	0.660		42	23	99.99%	99.99%	99.99%	99.99%
22	807	SR 976	SW 107TH AVE	2966	U-6DR	4	39	1.102	0.569		30	19	99.99%	99.99%	99.99%	99.99%
23	88	SR A1A	PALM ISLAND ENTRANCE	2737	S-6DR	3	48	1.460	0.228		26	33	99.99%	99.99%	99.99%	99.99%
24	651	SR 94	SW 127TH AVE	4334	U-6DR	4	36	1.306	0.569		46	14	99.99%	97.50%	99.50%	99.99%
25	918	SR 94	SW 132ND AVE	3964	U-6DR	4	28	1.104	0.569	1	35	11	99.95%	35.92%	97.50%	99.00%
26	822	SR 968	NW 42ND AVE	2136	U-6DR	4	37	1.096	0.569		28	22	99.99%	95.00%	99.95%	50.00%
27	344	SR 94	SW 117TH AVE	3995	U-6DR	4	44	1.813	0.569		45	22	99.99%	99.99%	99.99%	99.99%
28	522	SR 90	SW 122ND AVE	3730	U-6DR	4	37	1.469	0.569		48	15	99.99%	99.99%	99.99%	99.99%
29	34	SR 826	NW 2ND AVE	2020	U-OLA	3	52	2.261	0.240		40	25	99.99%	99.99%	99.99%	99.99%
30	102	SR A1A	BRIDGE RD	2738	S-6DR	3	46	1.399	0.228		19	33	99.99%	99.99%	99.99%	99.99%
31	30	SR 915	NE 125TH ST	2545	U-4DP	4	81	3.984	0.530		20	65	99.99%	99.99%	99.99%	99.99%
32	511	SR 5	EUREKA DR	4712	U-6DR	4	38	1.466	0.569		39	18	99.99%	99.99%	99.99%	99.99%
33	295	SR 7	SR 826 OFF-RAMP	3215	U-OLA	3	30	1.047	0.240		38	13	99.99%	99.99%	99.99%	99.99%
34	690	SR 94	SW 123RD CT	4898	U-6DR	4	35	1.270	0.569		36	12	99.99%	90.00%	97.50%	99.75%
35	328	SR 7	NW 199TH ST	3108	U-6DR	4	42	1.918	0.569		47	18	99.99%	99.99%	99.99%	99.99%
36	310	SR 916	NE 6TH AVE	3184	U-4DP	4	46	1.763	0.530		29	30	99.99%	99.99%	99.99%	99.99%
37	928	SR 976	SW 79TH AVE	4370	U-6DR	4	29	1.081	0.569		42	9	99.95%	40.64%	48.24%	35.56%
38	98	SR 5	SW 192ND ST	3872	U-6DR	4	54	3.182	0.569		56	21	99.99%	99.99%	99.99%	99.99%
39	611	SR 976	SW 57TH AVE	2599	U-6DR	4	37	1.334	0.569		30	15	99.99%	99.99%	97.50%	99.95%
40	383	SR 94	EB EXIT TO SB SR 874	4140	U-6DR	3	30	1.150	0.326		40	11	99.99%	99.99%	99.99%	99.99%
41	963	SR 5	SW 112TH ST	2954	U-6DR	4	33	1.016	0.569		21	24	99.95%	99.75%	97.50%	99.95%
42	134	SR A1A	TERMINAL ISLE	2736	S-6DR	3	41	1.306	0.228		15	30	99.99%	99.99%	99.99%	99.99%
43	471	SR 5	SW 16TH AVE	4680	U-6DR	3	33	0.947	0.326		15	23	99.99%	99.99%	99.99%	99.00%
44	233	SR 934	SR 7/US 441	2095	U-6DP	4	50	2.114	0.552		20	33	99.99%	99.99%	99.99%	99.99%
45	379	SR 997	TAMIAMI TRAIL	4198	R-4DR	4	21	1.314	0.302	3	11	12	99.99%	99.99%	99.99%	99.99%
46	396	SR 817	NW 207TH ST	3403	U-6DR	3	23	1.299	0.326	1	44	5	99.99%	99.99%	99.99%	99.99%
47	825	SR 5	SW 32ND AVE	2184	U-6DR	4	38	1.084	0.569		8	32	99.99%	99.99%	99.99%	97.50%
48	605	SR 972	SW 27TH AVE	2265	U-4DP	4	39	1.228	0.530		11	29	99.99%	99.99%	99.99%	97.50%
49	905	SR 985	FLAGLER ST	3894	U-6DR	4	26	1.140	0.569		41	9	99.99%	33.91%	95.00%	85.00%
50	461	SR 90	SW 82ND AVE	4565	U-6DR	3	23	1.156	0.326	1	31	8	99.99%	95.00%	99.99%	99.99%

NOTES:
1= FDOT's ranking was not used because it was solely based on the high-crash confidence level and it could be misleading when selecting the top intersections that may present safety deficiencies.
2= Crash rate is the number of crashes per million vehicles entering the intersection. The crash rate for intersections is calculated as follows: CR=(No. Crashes X 1,000,000)/(365*AADT). Crash rates presented in this table are for the year 2003.
3= The number corresponds to crashes reported in 2003.
4= The High Crash Confidence level is based on an statistical analysis used to determine if an intersection is considered a high crash intersection.

Table 2. Top 100 High-Crash Signalized Intersections in Miami-Dade County (Continued)

KHA's RANK	FDOT'S RANK[1]	MAJOR ROAD	MINOR ROAD	COUNTY ASSETID	RODWAY TYPE	No. OF LEGS	No. OF CRASHES IN 2003	CRASH RATES[2]		NUMBER OF			HIGH CRASH CONFIDENCE LEVEL[4]			
								ACTUAL	AVERAGE	FATALITIES[3]	INJURIES[3]	PROPERTY DAMAGE[3]	2003	2002	2001	2000
51	238	SR 94	SW 137TH AVE	3842	U-6DR	4	43	2.356	0.569		41	20	99.99%	99.99%	99.99%	99.99%
52	15	SR 992	SW 92ND AVE	4535	U-4DP	3	54	4.351	0.327	1	46	26	99.99%	99.99%	99.99%	99.99%
53	1003	SR 823	NW 173RD DR	5210	U-6DR	4	22	1.106	0.569	1	31	4	99.95%	90.00%	90.00%	75.00%
54	219	SR 5	SW 88TH ST	2953	U-6DR	3	36	1.566	0.326		29	21	99.99%	99.99%	99.99%	99.99%
55	256	SR 860	NE 15TH AVE	3807	S-4DR	3	22	1.230	0.207	1	36	2	99.99%	99.99%	99.00%	99.99%
56	255	SR 953	NW 11TH ST	4129	U-6DR	4	45	2.163	0.569		26	31	99.99%	99.99%	99.99%	99.99%
57	14	SR 922	WB EXIT TO I-95	3083	U-4DR	3	53	3.723	0.269		49	30	99.99%	99.99%	99.99%	99.99%
58	521	SR 5	SW 104TH ST	3147	U-6DR	3	30	0.924	0.326		15	20	99.99%	99.99%	99.99%	99.99%
59	810	SR 9	SW 16TH ST	2259	U-4DP	4	19	1.318	0.530	3	10	13	99.99%	99.99%	99.95%	43.75%
60	674	SR 9	NW 54TH ST	2486	U-4DR	4	25	1.151	0.445	1	17	15	99.99%	99.90%	99.99%	99.99%
61	643	SR 94	SW 142ND AVE	4652	U-6DR	4	27	1.479	0.569		48	8	99.99%	95.00%	99.99%	99.99%
62	418	SR 112	I-195	2650	U-INT	4	22	0.473	0.120		8	18	99.99%	99.95%	99.99%	99.99%
63	999	SR 976	SW 92ND AVE	3352	U-6DR	4	23	1.096	0.569	1	19	11	99.95%	97.50%	99.99%	95.00%
64	878	SR 924	SR 7/US 441	5176	U-6DR	4	31	1.103	0.569		18	18	99.99%	99.50%	99.99%	99.90%
65	512	SR 94	SW 97TH AVE	3581	U-6DR	3	26	0.996	0.326		26	11	99.99%	99.99%	99.99%	99.99%
66	925	SR 976	SW 67TH AVE	2963	U-6DR	4	24	1.154	0.569	1	18	15	99.95%	99.99%	99.99%	99.99%
67	784	SR 5	SW 136TH ST	3531	U-6DR	4	32	1.201	0.569		19	22	99.99%	99.99%	99.99%	99.99%
68	369	SR 9	NW 7TH ST	2333	U-6DP	4	38	1.765	0.552		24	23	99.99%	99.99%	99.99%	99.99%
69	661	SR 969	SR 934 CONNECTOR	3975	U-OLA	4	29	1.052	0.426		19	17	99.99%	99.99%	99.50%	99.99%
70	226	SR 9	N RIVER D	2404	U-6DP	4	44	2.296	0.552		25	28	99.99%	99.99%	99.99%	99.99%
71	361	SR 860	NE 18TH AVE	3293	S-4DR	4	28	1.566	0.406		41	7	99.99%	99.99%	99.99%	99.99%
72	528	SR 916	NE 10TH AVE	2555	U-4DP	5	40	2.068	0.830		25	26	99.99%	99.99%	99.99%	99.99%
73	312	SR 976	SW 117TH AVE	3613	U-6DR	4	40	2.029	0.569		23	25	99.99%	99.99%	99.99%	99.99%
74	777	SR 969	FLAGLER ST	3618	U-6DR	4	27	1.286	0.569		31	14	99.99%	99.99%	99.99%	90.00%
75	253	SR 90	SW 127TH AVE	5130	U-4DR	4	34	2.003	0.445		37	16	99.99%	99.99%	99.99%	99.99%
76	93	SR 9	SW 6TH ST	2239	U-6DP	4	53	3.157	0.552		20	41	99.99%	99.99%	99.99%	99.99%
77	65	SR A1A	WASHINGTON AVE	2794	U-6DR	4	60	3.779	0.569		17	49	99.99%	99.99%	99.99%	99.99%
78	543	SR 953	NW 7TH ST	2141	U-6DR	4	32	1.538	0.569		25	20	99.99%	99.99%	99.99%	99.95%
79	668	SR 94	SW 99TH CT	3831	U-6DR	3	23	0.881	0.326		22	8	99.99%	99.99%	99.99%	99.75%
80	320	SR 5	SW 200TH ST	2993	U-6DR	4	36	2.121	0.569		33	18	99.99%	99.99%	99.99%	99.99%
81	23	SR 915	MIAMI GARDENS DR	3238	U-4DP	3	45	4.483	0.327	1	47	17	99.99%	99.99%	99.99%	99.99%
82	818	SR 953	NW 14TH ST	2143	U-6DR	4	31	1.163	0.569		13	20	99.99%	99.99%	99.95%	99.50%
83	964	SR 973	SW 72ND ST	2885	U-4DR	4	24	0.871	0.445		18	11	99.95%	99.99%	99.99%	99.99%
84	912	SR 934	NW 27TH AVE	2499	U-6DR	4	27	1.121	0.569		20	17	99.99%	99.99%	99.99%	99.99%
85	544	SR 916	SR 7/US 441	3101	U-6DR	4	31	1.558	0.569		25	16	99.99%	99.99%	99.99%	99.99%
86	763	SR 860	NW 7TH AVE	3210	U-4DR	4	18	1.203	0.445	1	32	5	99.99%	99.99%	99.90%	99.99%
87	74	SR 907	5TH ST	2640	U-6DR	4	57	3.569	0.569		14	47	99.99%	99.99%	99.99%	99.99%
88	862	SR 5	SW 124TH ST	3090	U-6DR	4	30	1.126	0.569		12	22	99.99%	99.75%	97.50%	90.00%
89	774	SR 90	SW 109TH AVE	5430	U-6DR	3	16	0.913	0.326	1	23	5	99.99%	99.75%	99.99%	99.99%
90	652	SR 968	NW 84TH AVE	4860	U-6DR	4	27	1.465	0.569		32	10	99.99%	85.00%	90.00%	99.75%
91	448	SR 5	NE 187TH ST	3454	U-6DR	3	28	1.065	0.326		14	18	99.99%	99.99%	85.00%	97.50%
92	1014	SR 986	SW 107TH AVE	3966	U-4DR	4	24	0.838	0.445		14	16	99.95%	99.95%	99.99%	99.99%
93	735	SR 860	SR 5	3469	U-6DR	4	33	1.256	0.569		9	28	99.99%	99.99%	99.99%	50.00%
94	877	SR 90	LEJEUNE RD	2144	U-6DR	4	29	1.127	0.569		13	21	99.99%	75.00%	90.00%	90.00%
95	458	SR 968	NW 67TH AVE	2139	U-4DP	4	29	1.673	0.530		31	17	99.99%	99.99%	99.95%	99.75%
96	519	SR 5	NE 191ST ST	3178	U-6DR	3	26	0.989	0.326		14	16	99.99%	99.99%	99.99%	90.00%
97	240	SR 5	NE 36TH ST	2097	U-4DP	4	40	2.283	0.530		20	26	99.99%	99.99%	99.99%	99.99%
98	251	SR 976	SW 74TH CT	4374	U-6DR	3	32	1.538	0.326		18	20	99.99%	99.99%	99.99%	99.99%
99	311	SR 916	SR 5	3144	U-6DR	4	40	2.033	0.569		13	31	99.99%	99.99%	99.99%	99.99%
100	997	SR 932	SR 7/US 441	2509	U-6DR	4	25	1.070	0.569		18	14	99.95%	99.99%	99.99%	99.99%

NOTES:
1= FDOT's ranking was not used because it was solely based on the high-crash confidence level and it could be misleading when selecting the top intersections that may present safety deficiencies.
2= Crash rate is the number of crashes per million vehicles entering the intersection. The crash rate for intersections is calculated as follows: CR=(No. Crashes X 1,000,000)/(365*AADT). Crash rates presented in this table are for the year 2003.
3= The number corresponds to crashes reported in 2003.
4= The High Crash Confidence level is based on an statistical analysis used to determine if an intersection is considered a high crash intersection.

Figure 2. High-Crash Signalized Intersections in Miami-Dade County

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Due to the controversial nature of RLC systems, many public agencies do not have any official stance on the implementation of RLC systems. In fact, both the FHWA and NHTSA will only state that they acknowledge the effectiveness of RLC systems as a tool to be used in conjunction with other engineering countermeasures/improvements to lower RLR violations. [16, 18] According to the FHWA, the RLRD systems implemented in the 1994 Polk County study were set-up for the distinct purpose of evaluating RLC systems.

Based on discussions with FDOT Traffic Safety staff, it is believed that the same success found in the 1994 Polk County study may not be transferable to a county such as Miami-Dade County. The sheer size of Miami-Dade County would make it harder to inform motorists of intersections where RLRD systems were to be deployed as effectively as could be done in a county with fewer major intersections and fewer motorists to inform. It is likely that significantly more habitual RLR violators can be found in a large county such as Miami-Dade County than in a county with much smaller traffic volumes. As such, the "warnings" issued by the RLRD systems do not go to as large a percentage of habitual RLRs in areas with large traffic volumes [16] unless significantly more time and effort is devoted to the RLRD system.

This is of importance since the "warnings" being issued by the RLRD systems are most effective when issued to habitual RLR violators as opposed to the occasional RLR violator. Emphasis is placed on habitual RLR violators because of their ability to influence the tendencies of drivers around them. A typical motorist will not run a red light if they are the first car in line as they approach the intersection. However, that same driver has a higher propensity to run the red light if the driver in front of them has just done so, similar to a "copy-cat" behavior where the driver is now more willing to commit the offense once they have witnessed another already do so. It is this tendency that leads the habitual RLR's to alter driving behavior of motorists around them and increase occurrences of RLR. The reasoning for placing priority on issuing warnings to habitual RLR violators is to inform them of the dangers of RLR in hopes of convincing them to stop this practice.

The various demographics found in Miami-Dade County would require PSA's to be made in at least three different languages. It has been shown that once press releases and PSA's are discontinued that drivers' tendencies begin to revert back to what they were before implementation of the RLRD system.

Therefore, a sustained program of PSA's and press releases with up-to-date, intersection-specific information would be required.

Even with a sustained and organized effort to disseminate information to the public, there is always the issue of conformance. After a period of time has elapsed in which only warnings have been issued to RLR violators with no additional actions taken against them, motorists as a whole will begin to ignore the RLRD systems.

Although RLRD systems may provide some degree of improvement to traffic safety through the reduction of RLR occurrences, these may not be sustained improvements. As such, the RLRD system would not be considered a viable long-term engineering countermeasure/improvement to curb RLR in Miami-Dade County. In addition, the magnitude of the investment costs necessary for a RLRD system makes it difficult to justify choosing to implement this tool for what may appear to be unsubstantial or transient improvements. Utilizing the alternative procurement method of leasing the system still requires a large time commitment of at least three to five years. Opinions on the best methods and approaches to curb RLR may change drastically among officials and/or traffic operations and safety professionals in Miami-Dade County, leaving the County with the financial burden of a tool that may become unwanted or perceived as inadequate over time. For these reasons, it is our professional opinion that more cost-effective improvements/countermeasures should be explored to curb RLR in Miami-Dade County, such as those mentioned earlier in this report.

APPENDIX A

Miami-Dade Board of Commissioners (MDBCC) Directive to Miami-Dade County Manager

APPENDIX B

Miami-Dade County ATMS System Integrator Contract R-876-05 Work Order Authorization No. 11

APPENDIX C

Red Light Camera (RLC) System Locations Installed Nationwide

APPENDIX D

Florida Attorney General's Letter to the City of Pembroke Pines Attorney Pembroke

APPENDIX E

Proposed Bill HB 259 – Red Light Violations

APPENDIX F

City of Pembroke Pines Ordinance 2005-22

APPENDIX G

RLRE Questionnaire

APPENDIX H

High-Crash Signalized Intersections in Miami-Dade County in 2003

APPENDIX I

Relevant Studies and Reports

APPENDIX J

RLC System Vendor/Integrator Literature

APPENDIX K

Annotated Bibliography

ANNOTATED BIBLIOGRAPHY

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